Prime Factorization

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CONCEPT 1

Prime Factorization

Here you'll learn to write the prime factorization of given numbers using a factor tree.

Connor is working on prime factorization in math class. This has always been a tricky topic for him because he can't seem to remember which numbers are prime.

"I am never going to finish this," he tells his sister one afternoon.

"Sure you will. Just keep breaking down numbers until they don't get any smaller," his sister Cyndi tells him.

"What do you mean?"

"Which one are you on?" Cyndi asks looking over Connor's shoulder.

"This one, 60."

"That's a good one. Start with 12 times 5."

Connor writes down the following.

60 = 12 x 5

Do you know what to do next?

This Concept is about prime factorization. By the end of the Concept, you will know how to help Connor.

Guidance

In the last two Concepts, you learned about factors and prime numbers. Well, you can put these two skills together. We call that "prime factorization."

When we factored numbers before, we broke down the numbers into two factors. These factors may have been prime numbers and they may have been composite numbers. It all depended on the number that we started with.

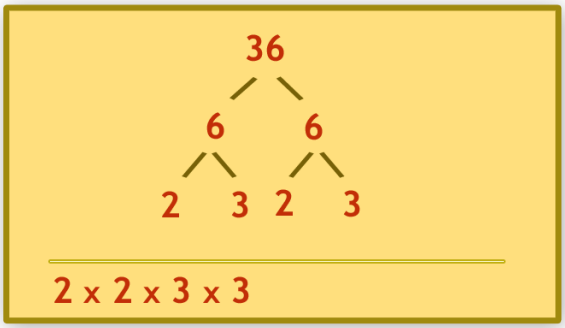
Factor 36

The number 36 can be factored several different ways, but let's say we factor it with 6×6. These two factors are not prime factors. Therefore, we can factor 6 and 6 again.

$$6 = 3 \times 2$$
$$6 = 3 \times 2$$

3 and 2 are both prime numbers.

When we factor a number all the way to its prime factors, it is called *prime factorization*. It is a little tricky to keep track of all of those numbers, so we can use a factor tree to organize. Let's organize the prime factorization of 36 into a factor tree.



Notice that at the bottom of the textbox, we wrote 36 as a product of its primes. **Is there any easier way to write this?** Yes, we can use exponents for repeated factors. If you don't have any repeated factors, you just leave your answer alone.

$$2 \times 2 = 2^2$$
$$3 \times 3 = 3^2$$

The prime factorization of 36 is $2^2 \times 3^2$.

Now it's time for you try a few on your own.

Example A

Factor 48 into it's prime factors.

Solution: The prime factorization of 48 is 3×2^4.

Example B

Factor 100 into it's prime factors.

Solution: The prime factorization of 100 is $5^2 \times 2^2$.

Example C

Factor 144 into it's prime factors.

Solution: The prime factorization of 144 is $3^2 \times 2^4$.

Remember Connor? Now let's go back to the original problem once again.

Connor is working on prime factorization in math class. This has always been a tricky topic for him because he can't seem to remember which numbers are prime.

"I am never going to finish this," he tells his sister one afternoon.

"Sure you will. Just keep breaking down numbers until they don't get any smaller," his sister Cyndi tells him.

"What do you mean?"

"Which one are you on?" Cyndi asks looking over Connor's shoulder.

"This one, 60."

"That's a good one. Start with 12 times 5."

Connor writes down the following.

60 = 12 x 5

Do you know what to do next?

Next, Connor needs to factor 12 and 5.

5 is prime.

12 = 3 x 4

Now factor 4.

4 = 2 x 2

Here is the final line of primes.

5 x 2 x 2 x 3

The prime factorization of 60 is $5 \times 2^2 \times 3$**.**

Vocabulary

Here are the vocabulary words used in this Concept.

Factors numbers multiplied together to equal a product.

Divisibility Rules a list of rules which help you to determine if a number is evenly divisible by another number.

Prime a number that has two factors, one and itself.

Composite a number that has more than two factors.

Prime Factorization writing a number as a product of its primes.

Factor Tree a diagram for organizing factors and prime factors.

Guided Practice

Here is one for you to try on your own.

What is the prime factorization of 81?

Answer

To complete this problem, we must first factor 81.

81 = (9)(9)

Next, we break down each 9 into it's factors

9 = 3 x 3 9 = 3 x 3

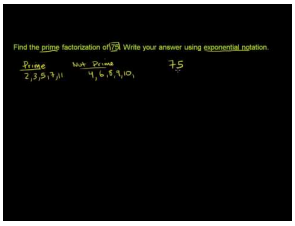
Since 3 is a prime number, this is as far as we can go.

The prime factorization of 81 is 3^4.

This is our answer.

Video Review

Here are videos for review.



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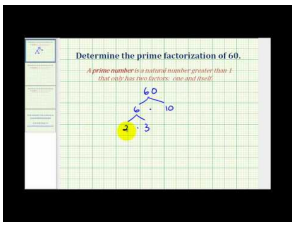
KhanAcademyPrime Factorization



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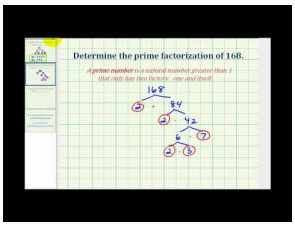
James Sousa Example of PrimeFactorization



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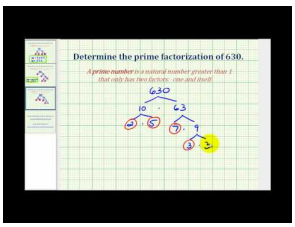
James Sousa Second Example of Prime Factorization



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James Sousa Third Example ofPrime Factorization

Practice

Directions: What is the prime factorization of each number?

1. 56
2. 14
3. 121
4. 84

5. 50
6. 64
7. 72
8. 16
9. 24
10. 300
11. 128
12. 312
13. 525
14. 169
15. 213